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Huang et al.

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(54) **CAMERA MODULE**

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(51) **Int. Cl.**
G02B 7/02 (2006.01)

(52) **U.S. Cl.** **359/824**; 359/814; 359/823; 396/133; 348/208.11; 348/335; 348/345

(58) **Field of Classification Search** 359/811, 359/814, 823, 824; 369/44.14–44.16, 44.22, 369/44.27, 112.23; 348/208.11, 335, 345; 396/89, 133; 310/12, 14, 15; 720/682, 683
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,271,511 B2 * 9/2007 Osaka 310/12
7,285,879 B2 * 10/2007 Osaka 310/12
7,298,562 B2 * 11/2007 Sue et al. 359/819
7,492,538 B2 * 2/2009 Ishizawa et al. 359/824
2006/0153556 A1 * 7/2006 Lee et al. 396/133
2006/0181632 A1 * 8/2006 Makii et al. 348/335
2006/0181748 A1 8/2006 Makii et al.
2008/0117536 A1 * 5/2008 Higuchi 359/824
2008/0192124 A1 * 8/2008 Nagasaki 348/208.11
2008/0259470 A1 * 10/2008 Chung 359/823

* cited by examiner

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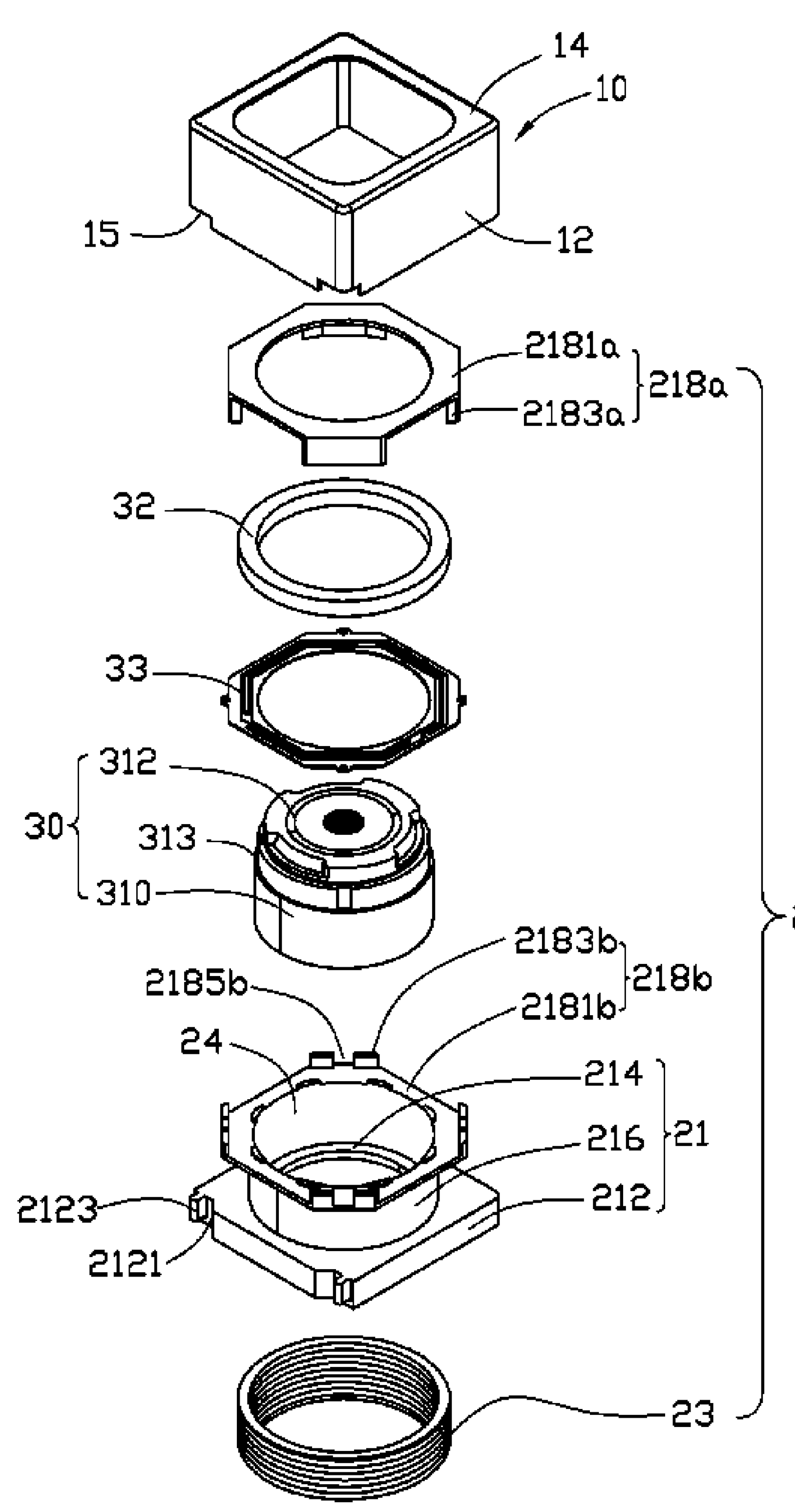
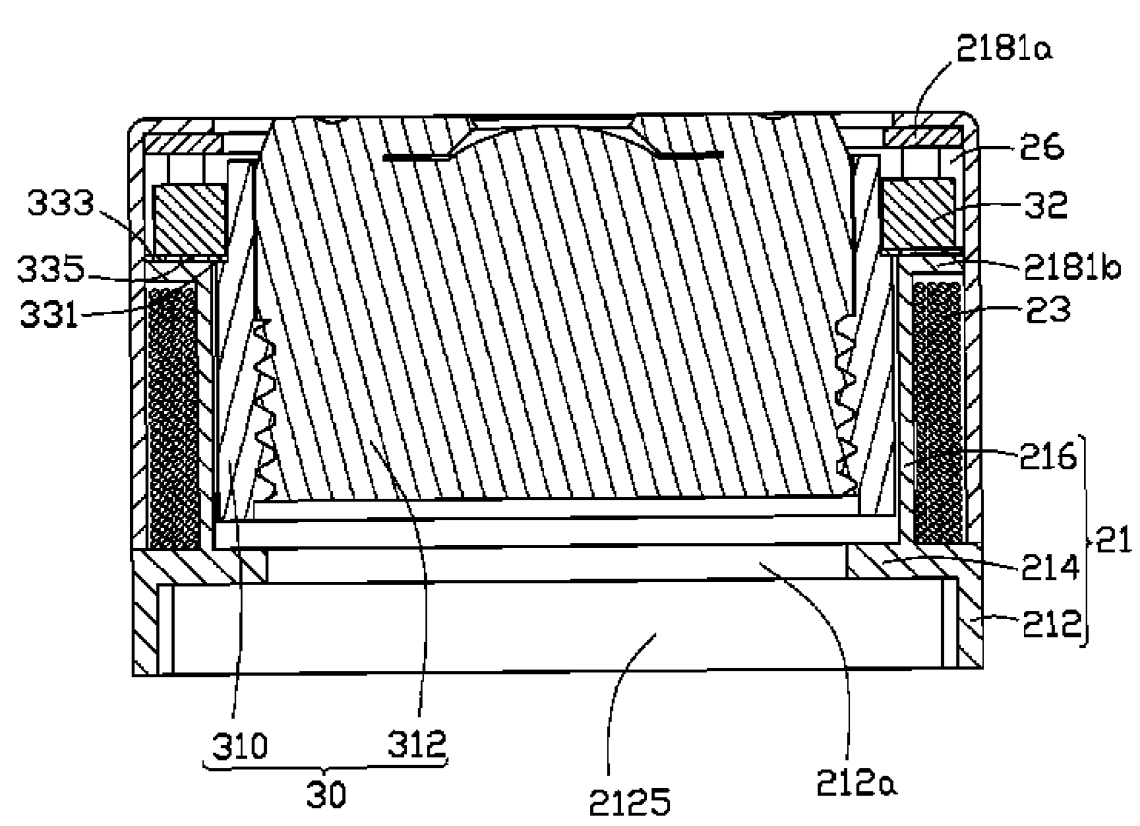
(57) **ABSTRACT**

A camera module includes a lens unit, a magnet mounted around the lens unit, a stator receiving the lens unit and the magnet therein and an elastic element. The stator includes a coil seat and a coil wound therearound. The coil establishes a magnetic field when an electric current is applied thereto. The magnetic field interacts with a magnetic field of the magnet to generate a magnetic force driving the lens unit into telescopic movement. The elastic element includes at least one rib which has a fixed end connected with the stator and an opposite movable end. The moveable end moves together with the lens unit with respect to the fixed end to generate an elastic force during the telescopic movement of the lens unit. The lens unit stops at a focal position when the magnetic force and the elastic force come to a balance.

17 Claims, 11 Drawing Sheets





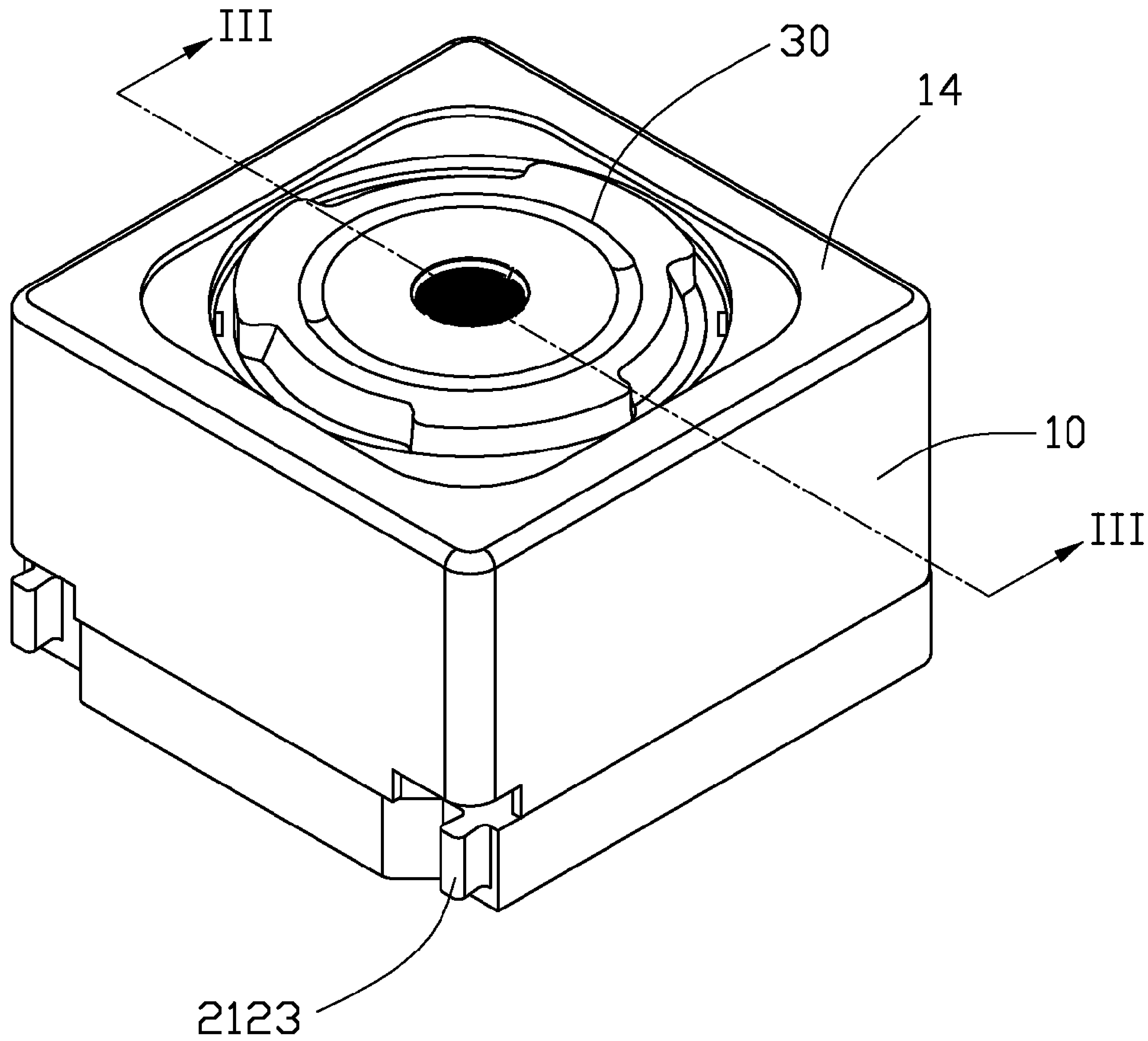
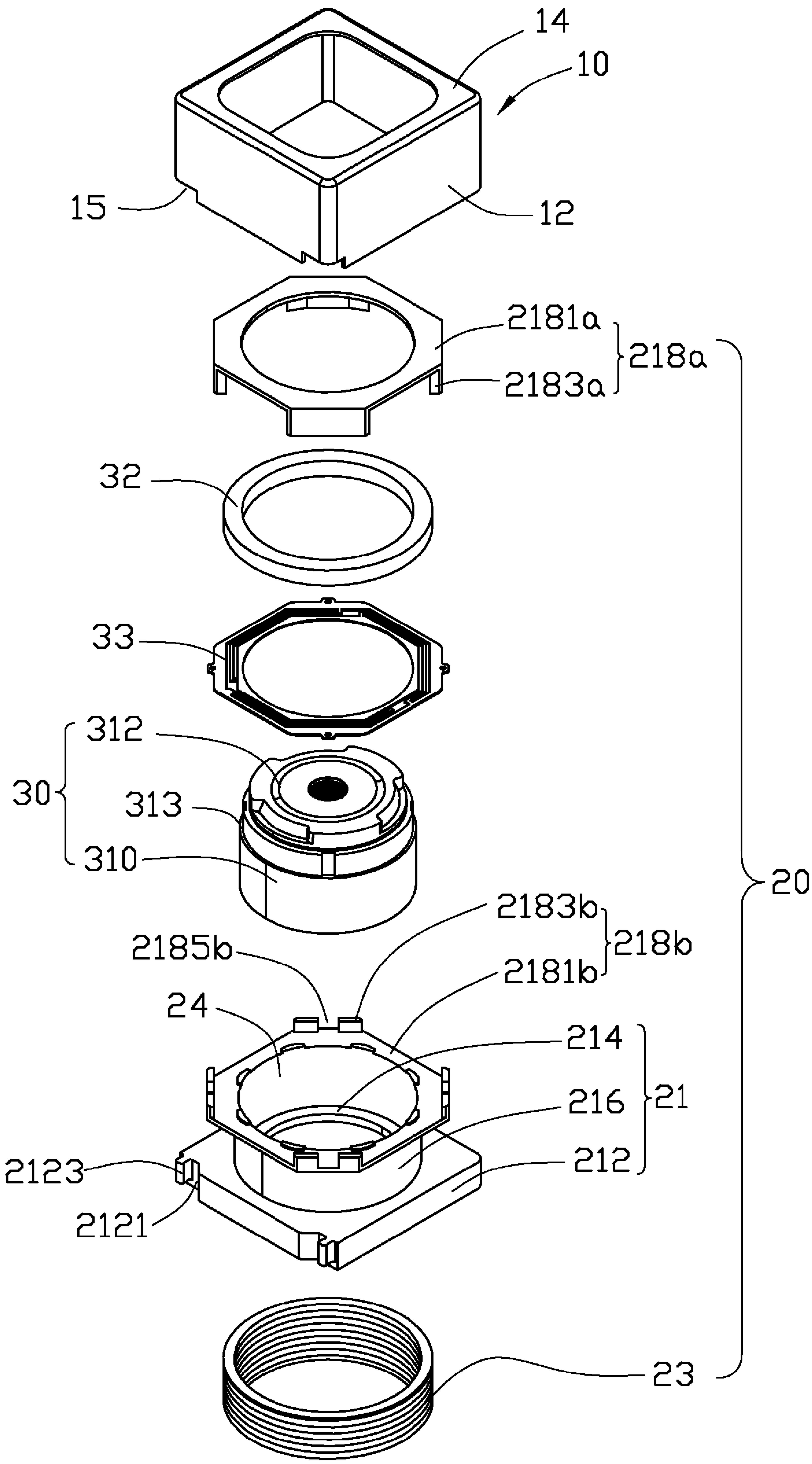


FIG. 1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10
15
12
2181a
218a
2183a
32
33
312
30
313
310
20
2183b
218b
2185b
2181b
24
214
216
21
2123
212
2121
23

FIG. 2

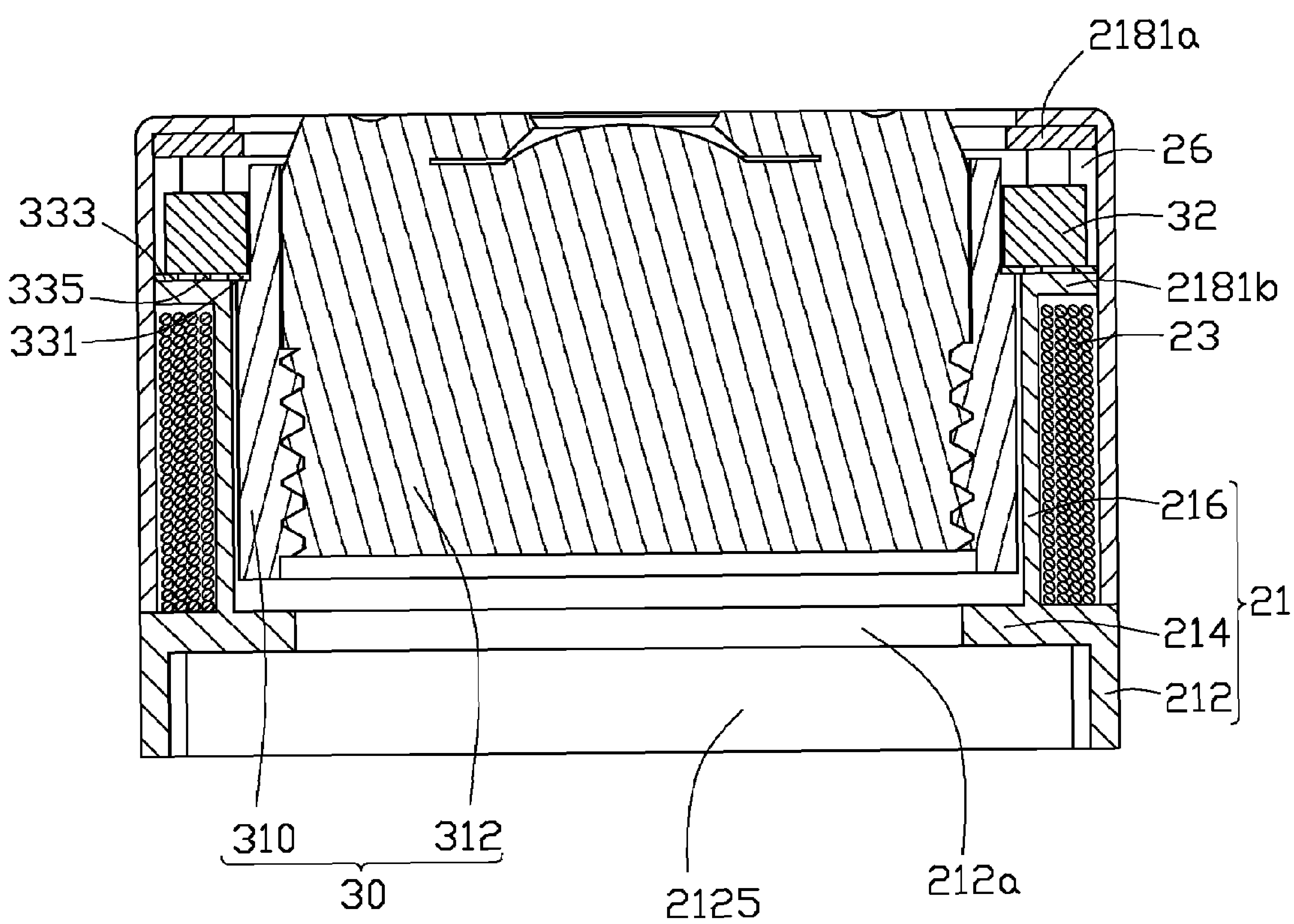
2181a
26
333
32
335
2181b
331
23
216
21
214
212
310
312
30
2125
212a

FIG. 3

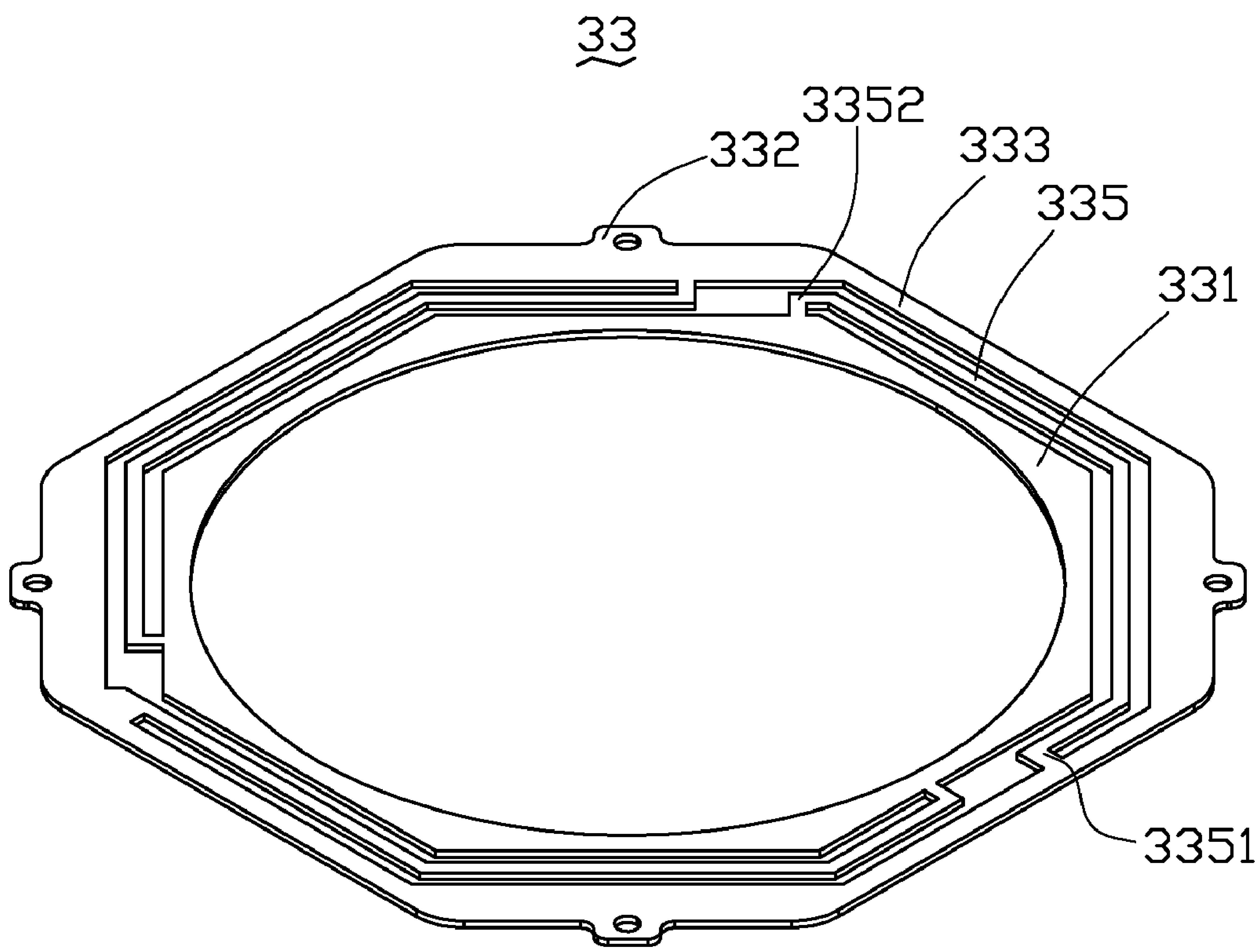

FIG. 4

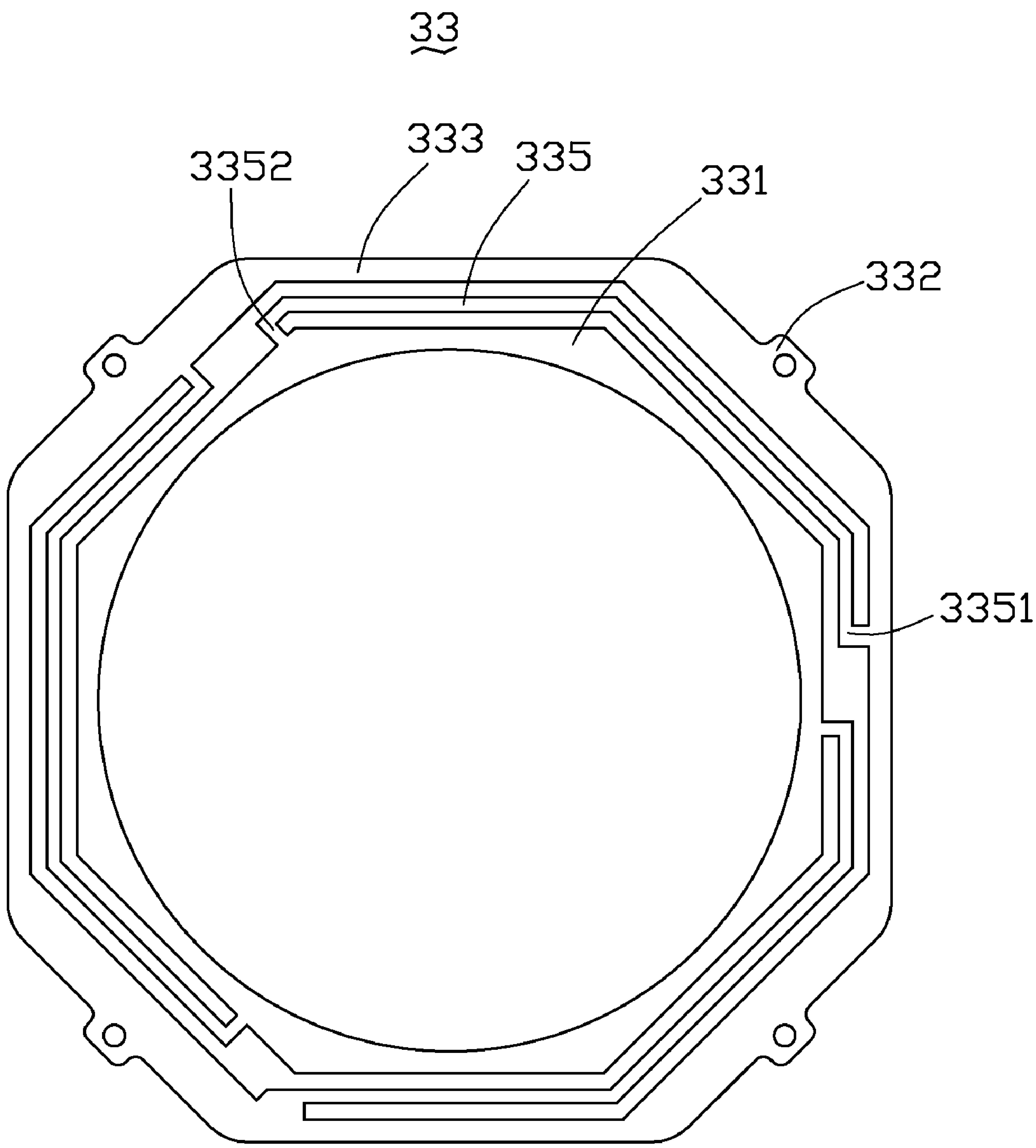

FIG. 5

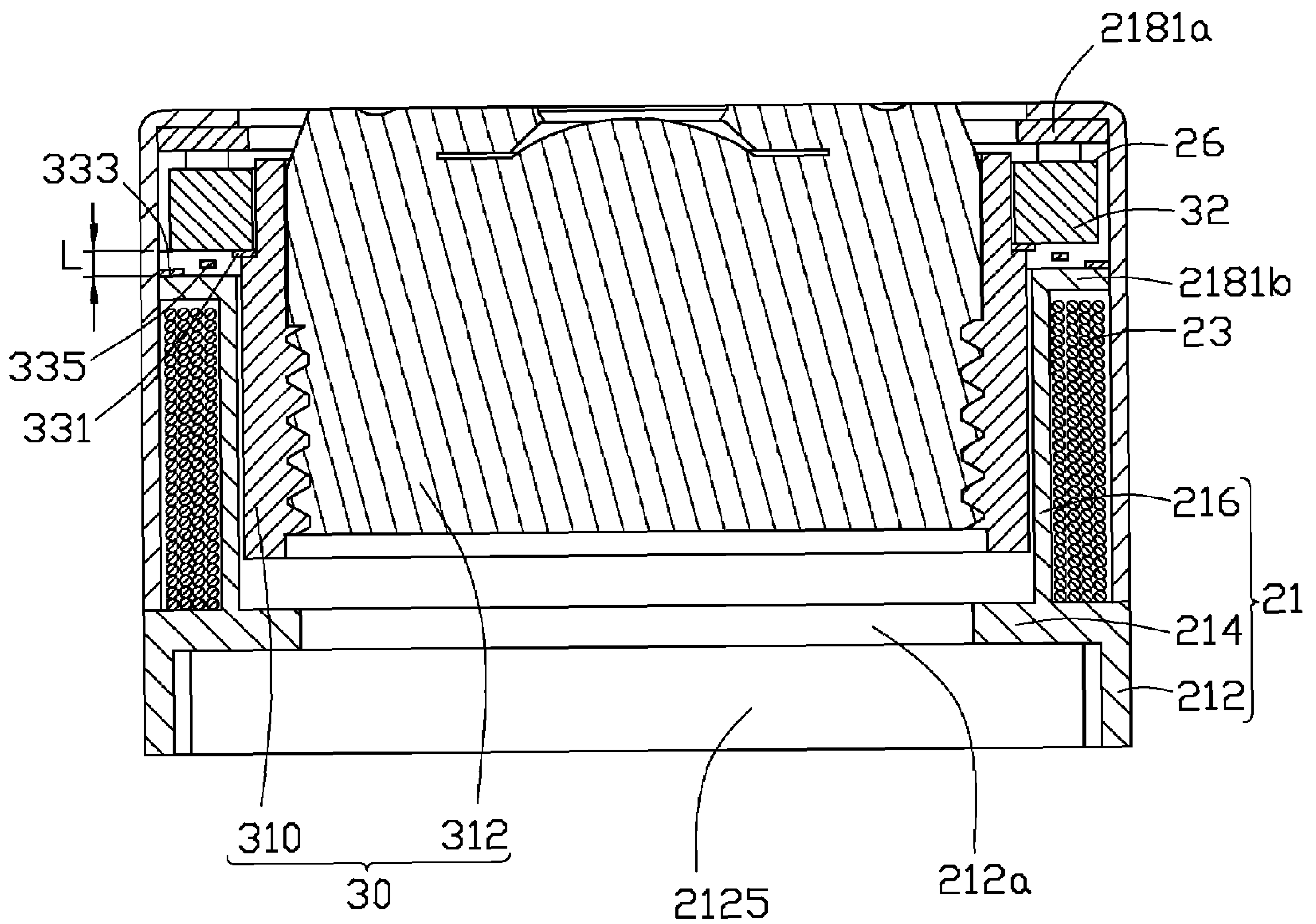
2181a
26
32
2181b
23
216
21
214
212
333
L
335
331
310
312
30
2125
212a

FIG. 6

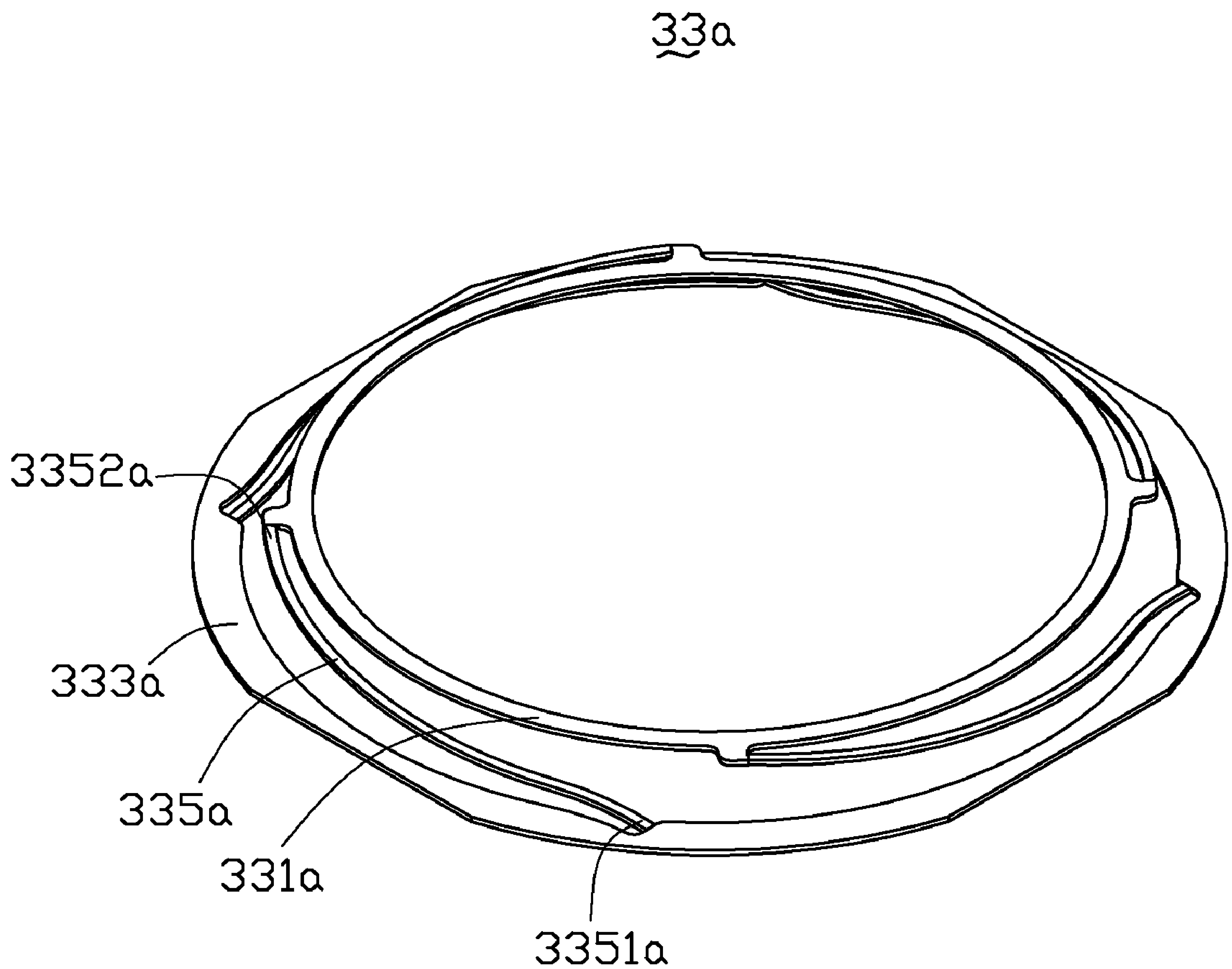

FIG. 7

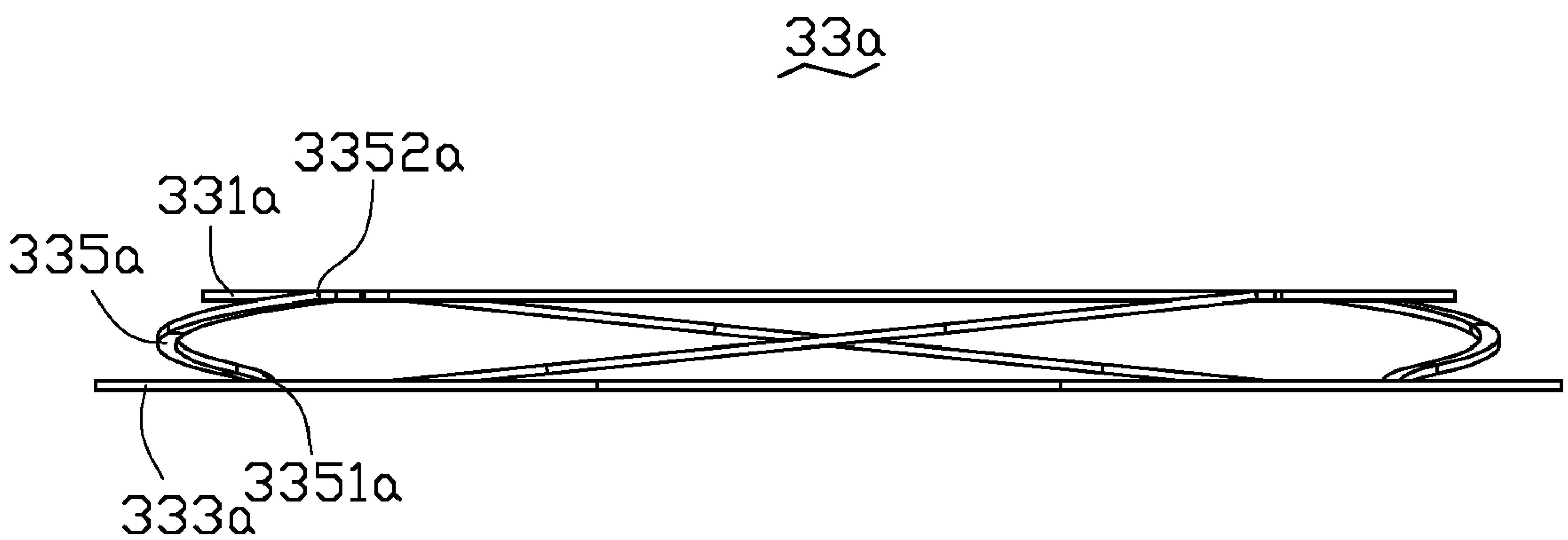

FIG. 8

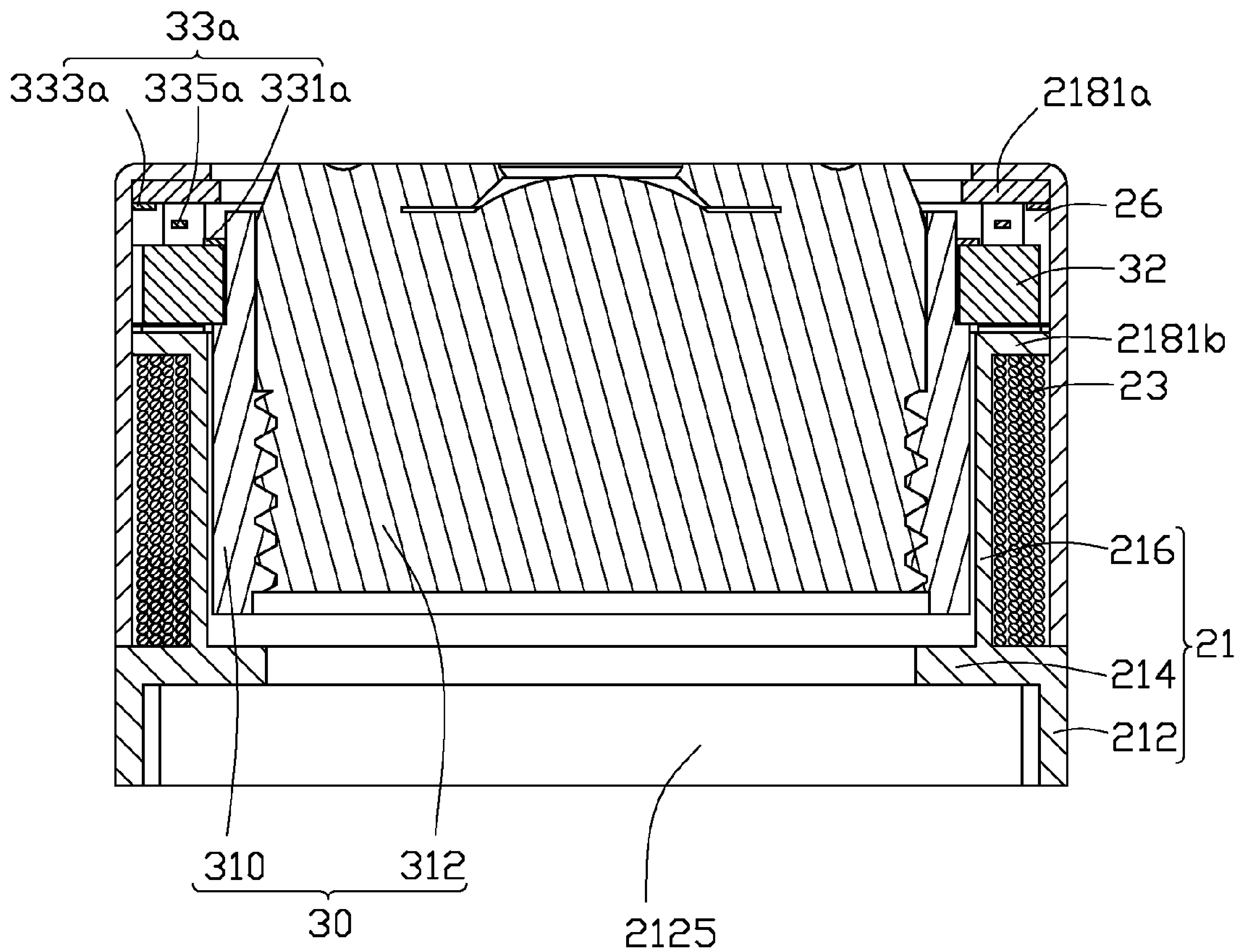
33a
333a
335a
331a
2181a
26
32
2181b
23
216
21
214
212
310
312
30
2125

FIG. 9

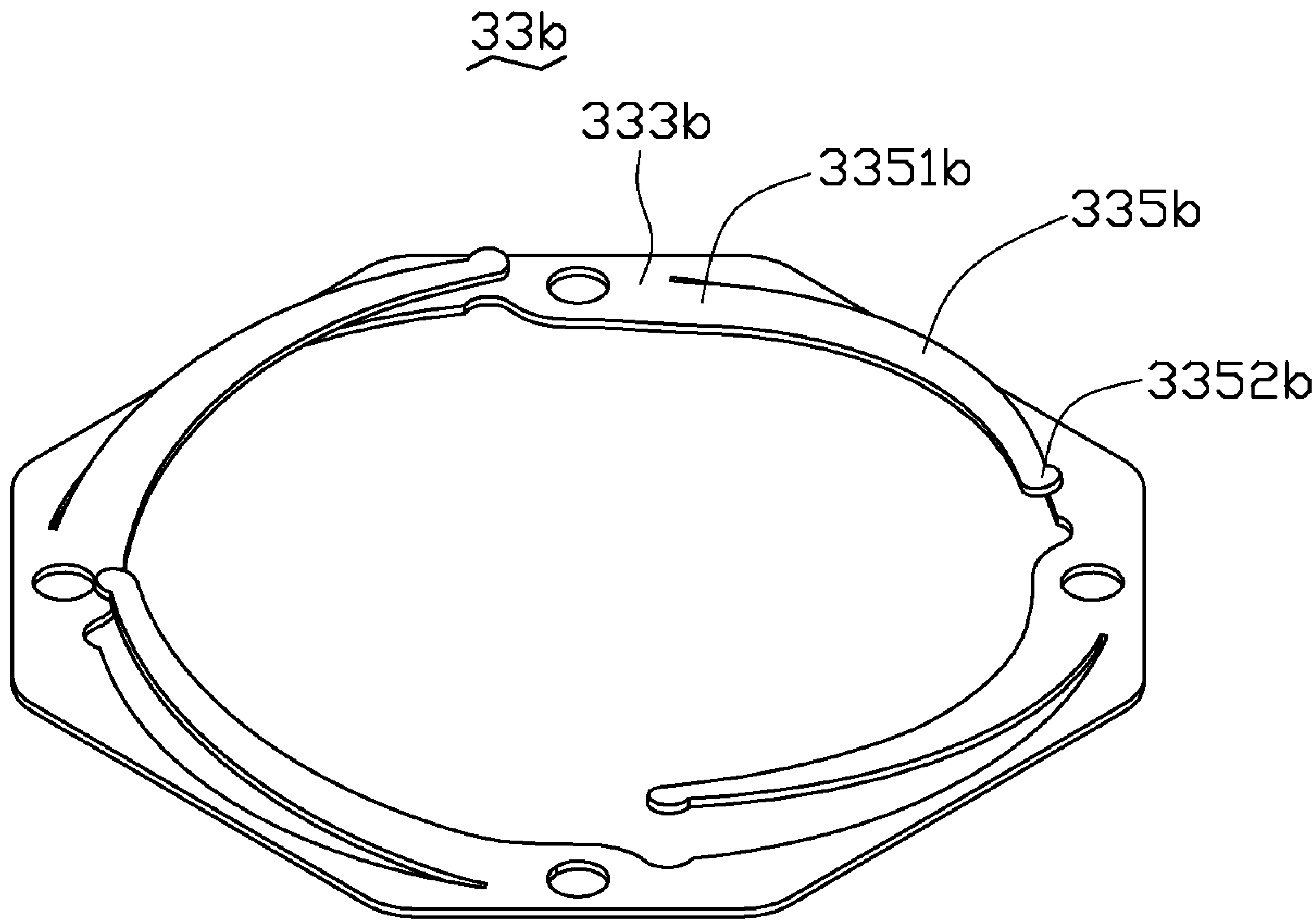

FIG. 10

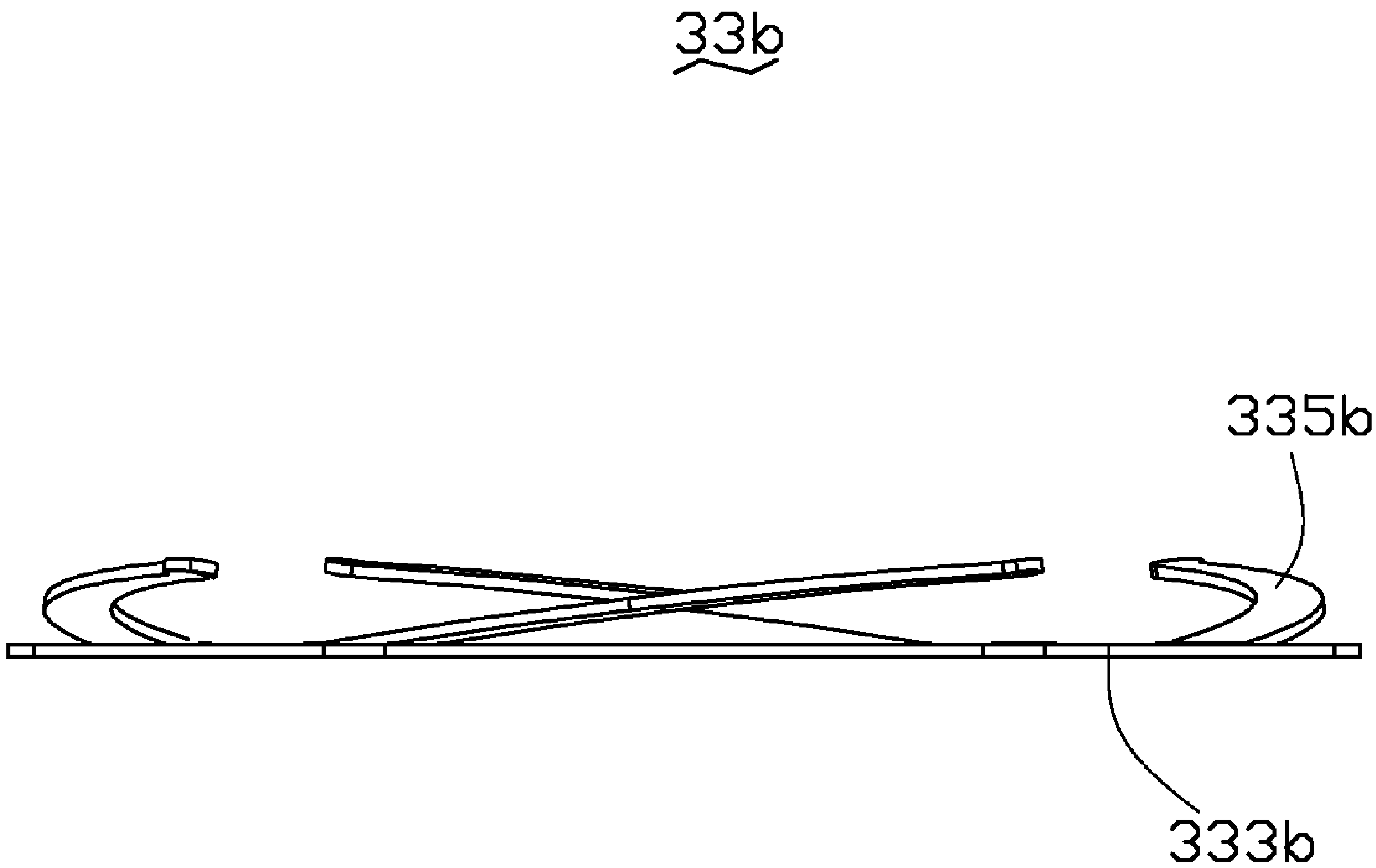

FIG. 11

CAMERA MODULE

BACKGROUND

1. Technical Field

The present invention relates to camera modules, and particularly to a camera module for use in a digital camera or a portable electronic apparatus such as a mobile telephone, a personal digital assistant, etc.

2. Description of Related Art

Camera modules are generally installed in mobile telephones, personal digital assistants or other portable electronic apparatuses to record the memorable moments due to their convenience and practicality. The designs of the camera modules have evolved toward lightweight and compactness tendency, so have the currently popular digital camera modules.

In the art, a two-step type camera module is proposed. The camera module generally includes a lens and a motor for driving the lens into telescopic movement. When the camera module operates, the lens is driven by the motor to move from a near focal point to a far focal point.

However, during the telescopic movement of the lens, the lens is driven by the motor to directly move from the near focal point to the far focal point. This kind of camera module has only two focal points, i.e., the near focal point and the far focal point. The lens cannot be precisely driven by the motor to stop at a precise position between the near focal point and the far focal point. Such a shortcoming needs to be solved.

SUMMARY

The present invention relates to a camera module. According to an exemplary embodiment of the present invention, the camera module includes a lens unit, a magnet, a stator and an elastic element. The lens unit includes a lens barrel and a lens received in the lens barrel and threadedly secured thereto. The magnet is fixedly mounted around the lens barrel. The stator receives the lens unit and the magnet therein. The stator includes a coil seat and a coil wound therearound. The coil establishes a magnetic field when an electric current is applied thereto. The magnetic field of the coil interacts with a magnetic field of the magnet to generate a magnetic force driving the lens unit into telescopic movement. The elastic element includes at least one rib. The at least one rib includes a fixed end connected with the stator and an opposite movable end. The moveable end of the elastic element moves together with the lens unit with respect to the fixed end of the elastic element to cause the at least one rib to deform and generate an elastic force during the telescopic movement of the lens unit. The lens unit stops at a focal position when the magnetic force and the elastic force come to a balance.

Other advantages and novel features of the present invention will become more apparent from the following detailed description of embodiment when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an assembled, isometric view showing a camera module in accordance with a first exemplary embodiment of the present invention.

FIG. **2** is an exploded, isometric view of the camera module of FIG. **1**.

FIG. **3** is a cross-section view of the camera module of FIG. **1**, taken along line III-III thereof.

FIG. **4** is an isometric view of an elastic element of the camera module of FIG. **2**.

FIG. **5** is a top plan view of the elastic element of FIG. **4**.

FIG. **6** is a cross-section view of the camera module of FIG. **1**, wherein a lens unit stops at a corresponding focus position.

FIG. **7** is an isometric view of an elastic element in accordance with a second exemplary embodiment of the present invention.

FIG. **8** is a front elevation view of the elastic element of FIG. **7**.

FIG. **9** is a cross-section view of a camera module using the elastic element of FIG. **7**.

FIG. **10** is an isometric view of an elastic element in accordance with a third exemplary embodiment of the present invention.

FIG. **11** is a front elevation view of the elastic element of FIG. **10**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made to the drawings to describe the various embodiments in detail.

Referring to FIGS. **1**-**2**, a camera module according to a first exemplary embodiment of the present invention includes a lens mount **10**, a lens unit **30** and a stator **20**. The lens unit **30** and the stator **20** are received in the lens mount **10**. The stator **20** is mounted around the lens unit **30** for driving the lens unit **30** into telescopic movement.

The lens mount **10** includes a rectangular sidewall **12** and a top rim **14** inwardly extending from a top end of the sidewall **12**. The lens mount **10** is hollow and has a rectangular cross-section with top and bottom ends being open. A space (not labeled) is thus defined in the lens mount **10** for receiving the lens unit **30** and the stator **20** therein. Two cutouts **15** are defined in two neighboring corners of the bottom end of the sidewall **12**.

The stator **20** includes a coil seat **21**, a coil **23** wound around the coil seat **21** and a claw assembly which includes a top claw element **218***a* and a bottom claw element **218***b*. The coil seat **21** includes a base **212**, a cylindrical sidewall **216** and an annular ledge **214**. The base **212** is square in profile and defines a central hole **212***a* (FIG. **3**) therein. Two cutouts **2121** are defined in two neighboring corners of the base **212** and positioned at opposite ends of a left lateral side of the base **212**. Two guiding pins **2123** outwardly extend from the opposite ends of the left lateral side of the base **212** and respectively extend into the cutouts **2121**. The sidewall **216** integrally and upwardly extends from an inner periphery of the central hole **212***a* of the base **212**. The annular ledge **214** inwardly and horizontally extends from the inner periphery of the central hole **212***a* of the base **212**, and is located at a bottom end of the sidewall **216**. The base **212**, the annular ledge **214** and the cylindrical sidewall **216** cooperatively form a receiving space **24** for receiving the lens unit **30** therein. Referring also to FIG. **3**, the base **212** and the annular ledge **214** cooperatively form an inner space **2125** for receiving an image sensor (not shown) therein. The image sensor is either a charge coupled device (CCD) sensor or a complementary metal oxide semiconductor (CMOS) sensor.

The bottom claw element **218***b* is located on a top side of the coil seat **21** and integrally connects with the coil seat **21** to form a single piece. The top claw element **218***a* is located on a top side of the bottom claw element **218***b* and faces to the bottom claw element **218***b*. The top claw element **218***a* includes an octagonal main body **2181***a* and four claws **2183***a* perpendicularly extending downwardly from four spaced sides of an outer periphery of the main body **2181***a* towards the bottom claw element **218***b*. The bottom claw element

218*b* includes an octagonal main body **2181***b* and four pairs of claws **2183***b* perpendicularly extending upwardly from four spaced sides of an outer periphery of the main body **2181***b* towards the top claw element **218***a*. The main body **2181***b* of the bottom claw element **218***b* outwardly and horizontally extends from a top end of the cylindrical sidewall **216** of the coil seat **21**. Each pair of claws **2183***b* of the bottom claw element **218***b* defines a guiding slot **2185***b* in a center thereof. Referring to FIG. **3**, the main bodies **2181***a*, **2181***b* and the claws **2183***a*, **2183***b* of the top and the bottom claw elements **218***a*, **218***b* cooperatively form a receiving room **26** after the top claw element **218***a* and the bottom claw element **218***b* are assembled together.

The lens unit **30** includes a tubular lens barrel **310** and a substantially cylindrical lens **312** fixedly received in the lens barrel **310**. An outer diameter of a top end of the lens barrel **310** is smaller than an outer diameter of a bottom end of the lens barrel **310**. An annular supporting step **313** is thus formed on an outer side surface of the lens barrel **310** between the top end and the bottom end. A plurality of first screw threads (not labeled) are formed on an inner surface of the bottom end of the lens barrel **310**. A plurality of the second screw threads (not labeled) are formed on an outer side surface of the lens **312**. The first screw threads are screwed into the second screw threads to connect the lens barrel **310** and the lens **312** together.

A magnet **32** is mounted around the lens unit **30**. An inner diameter of the magnet **32** is slightly larger than the outer diameter of the top end of the lens barrel **310**, but smaller than the outer diameter of the bottom end of the lens barrel **310**. The magnet **32** is supported on the annular supporting step **313** of the lens barrel **310**, and the inner surface of the magnet **32** is fixedly affixed to the outer side surface of the lens barrel **310**.

An elastic element **33** is located just under the magnet **32** and mounted around the lens unit **30**. Referring to FIG. **4** and FIG. **5**, the elastic element **33** includes an inner ring **331**, an outer ring **333** concentric with the inner ring **331** and three elastic ribs **335** integrally connecting the inner ring **331** with the outer ring **333**. An outer periphery of the elastic element **33** is octagon-shaped and substantially the same as the outer periphery of each of the main bodies **2181***a*, **2181***b* of the top claw element **218***a* and the bottom claw element **218***b*. The outer ring **333** and the inner ring **331** are spaced from each other along a radial direction. The elastic ribs **335** are evenly disposed along a circumferential direction of the elastic element **33** between the inner ring **331** and the outer ring **333**. Each of the elastic ribs **335** occupies approximately one third of a perimeter of the elastic element **33**. Each of the elastic ribs **335** connects the outer periphery of the inner ring **331** with the inner periphery of the outer ring **333**. The inner ring **331**, the outer ring **333** and the elastic ribs **335** are coplanar to each other. Four guiding tabs **332** horizontally and outwardly extend from four spaced sides of the outer periphery of the outer ring **333**. Each of the guiding tabs **332** has a size substantially equal to that of each of the guiding slots **2185***b* of the claws **2183***b* of the bottom claw element **218***b*. Each of the elastic ribs **335** has a first end **3351** connected with the outer ring **333** and an opposite second end **3352** connected with the inner ring **331**. A stiffness coefficient of the elastic element **33** along the radial direction of the elastic element **33** is larger than a stiffness coefficient of the elastic element **33** along an axial direction of the elastic element **33**. In this embodiment, the elastic element **33** is made of copper, the stiffness coefficient of the elastic element **33** along the radial direction is $3*10^4$ n/m (newton/meter), and the stiffness coefficient of the elastic element **33** along the radial direction is one hundred times of the stiffness coefficient of the elastic element **33** along the axial direction.

Referring back to FIG. **3**, the coil **23** is wound around an outer side surface of the cylindrical sidewall **216** of the coil seat **21**, with two ends of the coil **23** extending out through the two cutouts **15** of the lens mount **10** and wound around the guiding pins **2123** of the coil seat **21**, respectively. The ends of the coil **23** are further electrically connected to a power supply (not shown) of the camera module. The lens unit **30** is received in the receiving space **24** of the stator **20**. The annular supporting step **313** of the lens barrel **310** is substantially coplanar with the main body **2181***b* of the bottom claw element **218***b*. Both the magnet **32** and the elastic element **33** are mounted around the lens barrel **310** and received in the receiving room **26** between the top claw element **218***a* and the bottom claw element **218***b*. The guiding tabs **332** of the elastic element **33** are engaged into the guiding slots **2185***b* of the claws **218***b* of the bottom claw element **218***b* to prohibit rotation of the elastic element **33** and the lens unit **30**. The outer ring **333** of the elastic element **33** is affixed to the main body **2181***b* of the bottom claw element **218***b*. The inner ring **331** of the elastic element **33** is sandwiched between the magnet **32** and the supporting step **313** and affixed to a bottom surface of the magnet **32**. The receiving room **26** has a height greater than a sum of the heights of the magnet **32** and the elastic element **33**, so that the magnet **32** together with the lens unit **30** can move along an axial direction of the cameral module between the main bodies **2181***a*, **2181***b* of the top claw element **218***a* and the bottom claw element **218***b*.

During operation, an electric current is applied to the coil **23** according to an image signal from the image sensor. The coil **23** receives the electric current and accordingly establishes an induced magnetic field. The magnetic field of the magnet **32** interacts with the induced magnetic field of the coil **23** so that an upward magnetic force is generated. The magnetic force drives the lens unit **30** together with the magnet **32** into telescopic movement along the axial direction of the camera module. In other words, the lens unit **30** is driven to move upwardly along the axial direction of the camera module. The inner ring **331** and the second ends **3352** of the elastic ribs **335** move together with the lens unit **30**. The outer ring **333** and the first ends **3351** of the elastic ribs **335** maintain still. Thus, the elastic ribs **335** of the elastic element **33** are elastically deformed along the axial direction and extended upwardly toward the top claw element **218***a*, and a downward elastic force is accordingly generated by the upwardly elongated deformation of the elastic ribs **335**. When the lens unit **30** moves to a position where the elastic force and the magnetic force reach a balance, the lens unit **30** is therefore stopped at that position, and a focusing action of the camera module is accomplished. When the image detected by the image sensor changes, the intensity of the electric current applied to the coil **23** is accordingly changed to control the lens unit **30** to move to a corresponding focus position.

For example, during operation, an electric current of 0.4 A (ampere) is applied to the coil **23** according to the image signal from the image sensor. The coil **23** establishes an induced magnetic field. The induced magnetic field of the coil **23** interacts with the magnetic field of the magnet **32**. Thus, a repelling magnetic force is generated between the coil **23** and the magnet **32** to drive the lens unit **30** to move upwardly along the axial direction of the camera module. The second end **3352** of each elastic rib **335** of the elastic element **33** moves together with the lens unit **30** and the elastic ribs **335** are accordingly deformed. Referring to FIG. **6**, when the lens unit **30** upwardly moves a distance L of 0.2 cm (centimeter) with respect to the main body **2181***b* of the bottom claw element **218***b*, the second end **3352** of each elastic rib **33** also upwardly moves the distance L of 0.2 cm with respect to its first end **3351**. If, at this stage, the elastic force generated due to the deformation of the elastic ribs **335** comes to a balance with the repelling magnetic force generated by the interaction between the magnetic field of the magnet **32** and the induced magnetic field of the coil **23**, the lens unit **30** stops at its current focal position where the magnet **32** spaces 0.2 cm from the main body **2181***b* of the bottom claw element **218***b*, as shown in FIG. **6**.

In the present camera module, a mapping between the intensity of the electric current applied to the coil **23** and the corresponding focus position of the lens unit **30** is pre-established. The movement distance L (i.e., the distance between the corresponding focus position and the main body **2181***b* of the bottom claw element **218***b*) of the lens unit **30** is controlled by the intensity of the electric current applied to the coil **23**, while the intensity of the electric current is determined according to the image detected by the image sensor. When the elastic force generated by the elastic element **33** and the magnetic force generated by interaction between the coil **23** and the magnet **32** reach a balance, the lens unit **30** is stopped at the corresponding focus position. Therefore, the magnet **32** is able to precisely stop at different positions between the main bodies **2181***a*, **2181***b* of the top and the bottom claw elements **218***a*, **218***b* and the lens unit **30** is able to precisely stop at any desired focus positions of the camera module.

In addition, since the stiffness coefficient of the elastic element **33** along the radial direction is much larger than the stiffness coefficient of the elastic element **33** along the axial direction, the lens unit **30** is kept to move stably along the axial direction of the camera module. Thus, imbalanced movement of the lens unit **30** is avoided, so that the lens unit **30** can move smoothly and accurately to reach its focus position.

FIG. **7** and FIG. **8** illustrate an elastic element **33***a* in accordance with an alternative embodiment. Similar to the first embodiment, the elastic element **33***a* also includes an inner ring **331***a*, an outer ring **333***a* and three elastic ribs **335***a* interconnecting the inner ring **331***a* and the outer ring **333***a*. The inner ring **331***a* and the outer ring **333***a* are spaced from each other along the radial direction of the elastic element **33***a*. Each of the elastic ribs **335***a* has a first end **3351***a* connected with the outer ring **333***a* and a second end **3352***a* connected with the inner ring **331***a*. The difference of the second embodiment over the first embodiment is that the inner ring **331***a* is higher than the outer ring **333***a*, so that a height difference along an axial direction of the elastic element **33***a* is formed between the inner ring **331***a* and the outer ring **333***a*. Each of the elastic ribs **335***a* helically extends downwardly from the outer periphery of the inner ring **331***a* towards the inner periphery of the outer ring **333***a*.

Referring to FIG. **9**, a camera module using the elastic element **33***a* is shown. The magnet **32** and the elastic element **33***a* are mounted around the lens barrel **310** and received in the receiving room **26** between the top claw element **218***a* and the bottom claw element **218***b*. The outer ring **333***a* of the elastic element **33***a* is affixed to the main body **2181***a* of the top claw element **218***a*, whilst the inner ring **331***a* of the elastic element **33** is affixed to a top surface of the magnet **32**. The magnet **32** is fixedly mounted around the lens barrel **310** and supported on the supporting step **313** of the lens barrel **310**. The magnet **32** is located just under the elastic element **33***a*. The height of the receiving room **26** substantially equals to the sum of the heights of the elastic element **33***a* and the magnet **32**. Therefore, in this embodiment, the first end **3351***a* of each elastic rib **335***a* functions as the fixed end, and the second end **3352***a* of each elastic rib **335***a* functions as the moveable end.

During operation, the electric current having a corresponding intensity is applied to the coil **23** according to the image signal from the image sensor. The coil **23** establishes an induced magnetic field after receiving the electric current. The induced magnetic field of the coil **23** interacts with the magnetic field of the magnet **32** to generate an upward magnetic force which drives the lens unit **30** into telescopic movement along an axial direction of the camera module. The elastic element **33***a* is compressed, the second end **3352***a* of each elastic rib **335***a* moves together with the lens unit **30** upwardly, and the elastic ribs **335***a* are deformed. The elastic force is generated by the elastic element **33***a* in response to the deformation of the elastic ribs **335***a* for stopping and maintaining the lens unit **30** at the required focus position.

Alternatively, the moveable ends and the fixed ends of the elastic ribs **335***a* can be interchangeable. That is, the inner ring **331***a* of the elastic element **33***a* can be affixed to the main body **2181***a* of the top claw element **218***a*, whilst the outer ring **333***a* of the elastic element **33***a* can be affixed to the top surface of the magnet **32**. Thus, the first ends **3351***a* of the elastic ribs **335***a* move together with the lens unit **30** and function as the movable ends, and the second ends **3352***a* of the elastic ribs **335***a* remain still with the stator **20** and function as the fixed ends.

FIG. **10** and FIG. **11** illustrate the elastic element **33***b* in accordance with another alternative embodiment. Similar to the second embodiment, the elastic element **33***b* also includes an outer ring **333***b* and three elastic ribs **335***b* helically extending upwardly from the inner periphery of the outer ring **333***a*. The difference of the third embodiment over the second embodiment is that the elastic element **33***b* has no inner ring, and each of the elastic ribs **335***b* has a first end **3351***b* connected with the outer ring **333***b* and a second free end **3352***b* remote from the outer ring **333***b*. In use, the elastic element **33***b* is inverted from the position of FIG. **11**, the outer ring **333***a* is affixed to the bottom surface of the main body **2181***a* of the top claw element **218***a* of the stator **20**, and the second free end **3352***b* of each elastic rib **335***b* is affixed to the top surface of the magnet **32**. Accordingly, the first end **3351***b* of each elastic rib **335***b* functions as the fixed end, and the second free end **3352***b* of each elastic rib **335***b* functions as the moveable end.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A camera module comprising:

a lens unit comprising a lens barrel and a lens securely received in the lens barrel;

a magnet fixedly mounted around the lens barrel;

a stator receiving the lens unit and the magnet therein, the stator comprising a coil seat and a coil wound therearound, the coil establishing a magnetic field when an electric current is applied thereto, the magnetic field of the coil interacting with a magnetic field of the magnet to generate a magnetic force driving the lens unit into telescopic movement; and an elastic element comprising at least one rib, the at least one rib comprising a fixed end connected with the stator and an opposite movable end, the moveable end of the elastic element moving together with the lens unit with respect to the fixed end of the elastic element to cause the at least one rib to deform and generate an elastic force during the telescopic movement of the lens unit, the lens unit stopping at a focal position when the magnetic force and the elastic force come to a balance.

2. The camera module of claim **1**, wherein the elastic element comprises an inner ring and an outer ring concentric with the inner ring, the inner ring and the outer ring being spaced from each other along a radial direction of the elastic element, the fixed end of the at least one rib being connected with the outer ring, the moveable end of the at least one rib being connected with the inner ring.

3. The camera module of claim **2**, wherein the outer ring connects with the stator, and the inner ring connects with the magnet.

4. The camera module of claim **2**, wherein the inner ring, the outer ring and the at least one rib are coplanar to each other when the elastic element is at a natural state.

5. The camera module of claim **2**, wherein one of the inner and the outer rings is located at a higher level than the other one of the inner and the outer rings, and a height difference along an axial direction of the elastic element is formed between the inner ring and the outer ring when the elastic element is at a natural state.

6. The camera module of claim **1**, wherein the elastic element comprises an inner ring and an outer ring concentric with the inner ring, the inner ring and the outer ring being spaced from each other along a radial direction of the elastic element, the fixed end of the at least one rib of the elastic element being connected with the inner ring, the moveable end of the at least one rib of the elastic element being connected with the outer ring.

7. The camera module of claim **6**, wherein the inner ring of the elastic element is connected with the stator, and the outer ring of the elastic element is connected with the magnet.

8. The camera module of claim **6**, wherein the inner ring is located at a higher level than the outer ring, and a height difference along an axial direction of the elastic element is formed between the inner ring and the outer ring when the elastic element is at a natural state.

9. The camera module of claim **1**, wherein the elastic element comprises an outer ring connected with the stator, the fixed end of the at least one rib connected with an inner periphery of the outer ring, the moveable end of the at least one rib being a free end and connected with the magnet.

10. The camera module of claim **1**, wherein the stator further comprises a top claw element and a bottom claw element located on a top side of the coil seat, the top claw element and the bottom claw element cooperatively forming a receiving room therebetween, the elastic element and the magnet being received in the receiving room.

11. The camera module of claim **10**, wherein each of the claw elements comprises a main body and a plurality of claws extending from an outer periphery of the main body towards the other claw element, a plurality of guiding tabs are formed on an outer periphery of the elastic element, and a plurality of guiding slots for correspondingly receiving the guiding tabs therein are defined in the claws of the bottom claw element.

12. The camera module of claim **1**, wherein the coil seat comprises a base and a cylindrical sidewall extending upwardly from the base, the coil being wound around the cylindrical sidewall, the bottom claw element being provided at a top end of the cylindrical sidewall.

13. A camera module comprising:

a lens mount;

a stator received in the lens mount and having a coil;

a lens unit telescopically received in the stator and having a magnet secured thereto; and

an elastic element having at least a deformable rib having a fixed end secured to the stator and a movable end fixed to the lens unit;

wherein when the lens unit is telescopically moved relative to the stator, the at least a deformable rib is elastically deformed to generate a force counteracting the telescopic movement of the lens unit.

14. The camera module of claim **13**, wherein the fixed end and the movable end are at a same level when the elastic element is at a natural state, the elastic element further comprising an outer ring connecting with the fixed end and an inner ring connecting with the movable end, the inner ring being fixed to the lens unit and the outer ring being fixed to the stator.

15. The camera module of claim **13**, wherein the movable end is located below the fixed end when the elastic element is at a natural state, the elastic element further comprising an outer ring connecting with the fixed end and an inner ring connecting with the movable end, the inner ring connecting with the lens unit and the outer ring connecting with the stator.

16. The camera module of claim **13**, wherein the movable end is located above the fixed end when the elastic element is at a natural state, the elastic element further comprising an outer ring connecting with the movable end and an inner ring connecting with the fixed end, the inner ring connecting with the stator and the outer ring connecting with the lens unit.

17. The camera module of claim **13**, wherein the movable end is located below the fixed end when the elastic element is at a natural state, the elastic element further comprising an outer ring connecting with the fixed end, the movable end being a free end of the at least a deformable rib, the outer ring connecting with the stator and the movable end connecting with the lens unit.

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